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ABSTRACT

This paper suggests two steps in instructional deisgn for early childhood that can be derived from a recent major paper on instructional strategy taxonomy. These steps, together with the instructional design variables involved in each step, are reviewed relative to current research in child development and early education. The variables reviewed include content operations (identity, descriptive, productive), response conditions (rule remembering, rule using, rule finding), content and response modes (generality, example, expository, inquisitory), content and response representation (enactive, iconic, symbolic), and content and response helps (prompting, feedback). Hypotheses for further instructional strategies research in early childhood are suggested. (Author)

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A TAXONOMY OF INSTRUCTIONAL STRATEGIES IN EARLY CHILDHOOD EDUCATION: TOWARD A DEVELOPMENTAL THEORY OF INSTRUCTIONAL DESIGN*

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Bruner's (1960) hypothesis that, "any subject can be taught effectively in some intellectually honest form to any child at any stage of development" (p. 33) excited many researchers and educators during the 1960's and dismayed many others. The push for accelerated cognitive development and elevated I.Q.'s was on. Unfortunately, many of those who used this hypothesis to support their own research and instructional efforts in early childhood education overlooked Bruner's further statement that "the task of teaching a subject to a child at any age is one of representing the structure of that subject in terms of the child's way of viewing things (p. 33, italics added). Using the complete Bruner statement as a challenge, this paper will propose and examine two steps involved in instructional development in the cognitive domain as they relate to instruction in early childhood (ages three through 8). These steps suggest a taxonomy and a metatheory (Snow, 1973) of instructional design from which hypotheses can be derived relative to instructional design for early childhood that deal with the qualitative differences in the mode of learning in young children compared to

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older children. The steps described in this paper will be exemplified where possible with present early childhood instructional development efforts by the author and by some recent research in instruction for young children. Emphasis is on the cognitive domain of instruction because most instructional development for early childhood involves the cognitive domain. However, the instructional development steps described here can be adapted easily to the psychomotor domain. The affective domain is here considered an integral process of all instruction.

The two major steps in instructional development and their major subdivisions described herein are as follows:

1. Determine the instructional objectives.
   - (a) Determine the cultural expectations of the child's society.
   - (b) Determine identities, definitions, and propositions relative to cultural expectations in any given content area of the curriculum.
   - (c) Determine what should be taught based on developmental level and cultural expectations.
   - (d) Determine content sequence.
   - (e) Determine the instructional objectives.
2. Determine instructional procedures and display devices.
   - (a) Determine the primary presentation forms for content and for expected child responses.
   - (b) Determine the modes of representation for the primary presentation forms.
   - (c) Determine instructional helps for the primary presentation forms.

Before explaining each of these steps, let me define four basic concepts--"instruction," "curriculum," "learned behavior," and "instructional development." Instruction is "a specific effort by the instructor to modify the environment in such a way that specific learning will result in the learner" (Vance, 1973). It is a process. Curriculum is the content or subject matter of instruction. Learned behavior in this context is more or less permanent, sequential behavior change in the student (child) resulting from training, observation, and/or practice. It is the desired product of instruction. Instructional development is the systematic planning and production of those environmental elements related to the instructional objective which, when used as directed in the instructional process, will most likely lead to the desired learned behavior. The steps in instructional development described in the remainder of this paper should occur before the resulting instructional program is implemented on a broad scale in the instructional process.

Merrill and Wood (1974) have developed a model that views instructional development as a geometrical figure called a tetrahedron illustrated in Figure 1. The four basic components of instructional development in this model are student aptitude, subject-matter content, instructional strategies, and delivery systems. Notice that in the model each of these components is related directly to each of the others. The Merrill and Wood publication deals almost exclusively with the components within the instructional strategies domain of the model. They are presently preparing a book explicating the entire model. Each step described in the present paper is related to one or more of the four components of the Merrill-Wood

model as applied to early childhood instructional development. The aptitude component of the model is the thread running throughout the instructional development sequence.

Figure 1 Here

STEP 1: DETERMINE THE INSTRUCTIONAL OBJECTIVES

Obviously there is no point in instructional development unless the developer knows where he is going. This step is primarily related to the content area of the Merrill and Wood model. Using architecture and the building trade as sources of metaphors, content can be viewed as the type of building the architect must plan. Before he begins his drawings, he must have a knowledge of basic building materials and how they relate to each other in terms of physical stress factors, aesthetics, and so on. He also must find out who the tenants of the building will be and how the building can best suit their needs and desires and budgets. In instructional development, the basic building materials are the various subject-matter areas of the curriculum including the hierarchies and heterarchies of concepts and propositions within each area (Merrill & Gibbons, 1974). The tenants are young children, together with their varying developmental levels of experience and capacities to learn.

When Robert Mager's (1962) booklet on behavioral objectives hit the educational community like a storm in the early 60's many educators, especially many working with prekindergarten children, were severe critics of the "behavioral

objectives" movement. They feared such specification of learning outcomes would mechanize and dehumanize the educational process and would ignore developmental or maturational limitations of young children. To a degree the critics were correct. Many objectives were so trivial they could easily reduce the child to a rote memory robot if used in instruction. But just as our modern technology can produce jet aircraft far better than that flown by Wilbur and Orville Wright at Kittyhawk, so can today's instructional objectives far surpass the kind described by Mager. Instructional psychologists today know far more about the instructional process and the content areas of instruction than they did a decade ago. So it is time we devoted our efforts to creating superior instructional objectives for early childhood education instead of criticizing those who create inferior ones. Let me suggest how we might do this.

Determine the Cultural Expectations of the Child's Society

First, I suggest we take a close look at the real world the child lives in and our expectations of the child in that real world. As I interview parents and follow the trends in early childhood education in my middle-class world, I hear expectations described by the following terms:

personal cleanliness
obedience to rules
independence
flexibility
resourcefulness
good judgment
social maturity
self esteem
self control
well-developed conscience
aesthetic appreciation
creativity

perceptual descrimination	logical reasoning
attention	reflection
wide variety of interests	reading and writing
curiosity	math skills

The list, of course, is much longer. These are abstract terms which have different behavioral connotations in society. For example, independence to a mother in a middle-class suburb may mean Mary can dress and undress herself without being asked. But independence may mean to a mother in a migrant farm camp that Maria can care for and feed her two little brothers while her parents work all day in the fields. Social maturity to a mother in an urban ghetto may mean that Frankie can defend himself physically when other boys in the neighborhood attempt to take away a prized possession such as a ball. In contrast, social maturity to a mother in a city penthouse may mean Francis can describe what he feels instead of using his fists when another child threatens to take away a prized possession. Regardless of where the child goes to school, those who are responsible for his instruction have a responsibility to determine the values and expectations of that particular subculture and the behavioral instances representatitve of each of these expectations. From this can evolve the instructional objectives deemed important for children in school in any given subculture. Obviously not all expectations of a given subculture can or should be taught in prekindergarten, elementary, or secondary schools. Some sources are available containing generally accepted goals (expectations) of the larger society in which the average child must learn to adapt (e.g., Education Policies Commission, 1938; Hand, 1948; Havighurst, 1953;

Kearney, 1953). These sources provide ideas for generally acceptable societal expectations appropriate for use in instruction. Many of these goals would be suitable for instruction in early childhood.

Determine Identities, Definitions, and Propositions Relative to Cultural Expectations in Any Given Content Area of the Curriculum

A statement of cultural expectation is not an instructional objective. It is not specific, nor is it observable. The next step is to select the areas within the curriculum that relate to a given cultural expectation.

Subject matter exists independent of the learner. We impose some form of order upon subject matter according to our educational purposes, in this case instructional objectives. This idea is relatively new in instructional development. Any given subject matter can be subdivided into identities, definitions and propositions as described in Table 1. This procedures is not the same as topical outlines, such as those at the end of each curriculum area in the prekindergarten described in Vance (1973). There is not space to discuss in detail the most recent work done in content analysis. The reader is referred to Merrill (1973), Merrill & Boutwell (1973), and Merrill & Gibbons (1974). However, before adequate instructional objectives can be planned for early childhood expectations of the child's culture must be matched with the identities, concept definitions and propositions of such curriculum content areas in early childhood as graphic arts, health and safety, the world of people, the biological world, the physical world, mathematics, movement, music, and reading (Vance, 1973). For example impor-

tant concepts for most young children to learn in the "world of people" curriculum evolve from such topics as families, homes people live in, holidays and special days, food preparation, relating to others in school, rules at home and school, feelings, money, people and places in the community, subcultures within the community, people in other countries, and people of other times (Vance, 1973). Each of these topics can be divided into hierarchies and heterarchies of identities, definitions, and/or propositions related to a given cultural expectation.

Table 1 Here

Determine What Should Be Taught Based on Developmental Level and Cultural Expectations

It is likely that the list of identities, definitions, and propositions derived from the previous list is too long for adequate instruction in early childhood. It is at this point that some decisions must be made about what should be taught.

Young children think and act in ways that are qualitatively different from older children and adults. They have had fewer experiences and less opportunity to integrate these experiences. It is likely the young child's ability to process information is limited by maturational factors, as suggested by the Swiss psychologist, Jean Piaget, in virtually all of his reports of his descriptive research with children. It seems reasonable to assume that many identities, definitions, and propositions are simply too difficult for the young child to understand, no matter

how they are presented. However, some apparently abstract identities, definitions, or propositions, when recast in terms of their concrete elements can be translated into the child's way of thinking.

For example, I and my associates are presently developing an instructional program on fire use and prevention which parents can use to instruct their children between the ages of four and seven. This instructional program is an outgrowth of recent studies indicating that a large proportion of man-caused fires are set by children between ages four and eight. A recent study by Block and Block (1975) of maternal teaching strategies in the use of fire materials and the attitudes toward and behavior with fire by young children suggested the need for instruction for young children in how to use fire materials safely, when to use fire materials, how to act in an emergency, and how to predict the consequences of behavior in given situations relative to fire. On the surface, these appear to be cultural expectations that can be translated easily into effective instruction for young children. However, this was not the case. A simple concept like "things that burn" had to be subdivided into two concepts, "things that burn with a match" and "things that burn when something else is burning." The definition for the concept, "things that burn with a match," had to be translated into concrete terms the young child could understand. The definition resulted in a statement of two critical attributes or characteristics, at least one of which each thing that burns with a match must have in order to fit the category: "Things that can be set on fire with a match must be dry or must have oil or gasoline in them." (See Table 1.) This definition contains two concepts that must be defined for

those children who don't understand them: "things that are dry" and "oil and gasoline." Because children are not likely to learn how to use fire materials safely until they can identify things that burn with a match, instruction had to be developed that first dealt with not only the concept "things that burn with a match," but also "things that are dry" and "oil and gasoline."

Because young children are generally incapable of processing concepts with definitions that have more than two concrete critical attributes, we had to plan each definition in the fire use and prevention instructional program around one or two critical attributes. For instance, the definition of "a dangerous fire situation" ("potentially dangerous fire situation," in adult terms) became, "A dangerous fire might get started if there is something that will burn (first attribute) and something that will make it burn (second attribute)." (See Table 1.)

There are no hard and fast rules for selecting content to be taught to young children. However, before instructional developers select the identities, definitions, and propositions that should be taught in any early childhood curriculum, the following may be helpful guidelines:

1. Select content that appears most relevant to the highest priority cultural expectations.

2. Select content that is prerequisite to the learning of high priority cultural expectations.

3. Select content that can be stated in concrete terms requiring a short memory load for the child.

Determine Content Sequence

What concepts (definitions) must be learned before other concepts can be learned? What concepts must be learned before specific propositions can be

learned? What propositions must be learned before other propositions can be learned? Are there any identities that must be learned before particular concepts or propositions can be learned? The answers to these questions involve the process of sequencing instruction.

Again, there are no hard and fast rules for the optimal sequence of content in any given subject matter. There is not enough information available yet from research with information processing in children to provide fool-proof rules. The developer's common sense and observed data from children can provide clues for the most desirable instruction. Sometimes it doesn't really matter in which order the content is presented. For instance, our fire prevention instructional program involves three main content areas: consequences of behavior with fire, fire emergencies, and safe use of fire materials. As we looked at the definitions and propositions for each of these content areas we decided that it didn't matter which of the three content areas were presented first in instruction. However, when we carefully examined the concepts and propositions in each of the three content areas we found some hierarchies appearing. That is, it is likely that a lesson on the concept of "fire emergency" is desirable before the child learns the procedures (proposition) necessary to follow in a fire emergency. It is likely the concept of "dangerous fire situation" should be taught before the concept, "when it is safe to light a fire." Formative evaluation is now providing us data on whether or not our "best guesses" were good ones in the sequencing of fire prevention and fire use content. But the concept of formative evaluation in early childhood instructional development is a topic for another paper.

Determine the Instructional Objectives

When identities, definitions, and propositions in each curriculum area have been identified which relate to subcultural expectations of children, the next step is to translate these into instructional objectives that are specific and measurable. It is at this point where behaviorally stated objectives become important in the instructional planning process. But it is precisely at this point where criticism can be leveled at many, if not most, instructional objectives in early childhood education. It is here that objectives can become trivial and ignore developmental or maturational levels.

First, let's deal with the problem of trivial objectives. A few years ago one of my colleagues spent several weeks planning behavioral objectives for a child development course. He arrived at the stupendous number of 5,257 objectives for a one-semester three-unit course! You probably have heard of fellow educators spending their time at workshops before school starts in the fall or even during the school year grinding out behavioral objectives for various areas of the curriculum. Just as with my colleague, you will find that most of these objectives begin with, "be able to name...," "be able to tell...," "be able to identify...," "be able to state...," and so on. In other words, our colleagues have been caught in a trap where they are limited to observable behaviors (i.e., name, tell, list, identify, state) which are usually low-level memory behaviors. They say to themselves, "Certainly there must be more to objectives than this." And there certainly is. Consider the fact that knowledge is doubling about every five years

at the present rate. Thus, it is impossible to teach the child by the time he is 18--or 80--all the information there is to know--or even that he needs to know to cope in the world. Our responsibility, then, is to plan most objectives where the child will "learn how to learn" so that he can meet each new challenge or problem and find his own best solution when no one is there to show him what to do. What I am suggesting is that we emphasize objectives that require transfer behavior or, in other words, classification, rule-using, and rule-finding objectives described in Table 2. These objectives would evolve out of the expectations of the child's subculture. Once the decision is made as to what concepts and rules are necessary for a child to learn in order to meet the expectations of his subculture, it is a relatively simple process to generate classification, rule-using, and rule-finding objectives. That is, if we can determine the basic content related to cultural expectations, objectives can be determined to fit the model for any given type of behavior. There is a discrete set of characteristics of objectives for each type or level of behavior, including memory behavior, classification behavior, rule-using behavior, and rule-finding behavior (See Table 2).[1]

Table 2 Here

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[1] Affective instructional objectives have been deleted from this paper on purpose. Affect is considered primarily a function of the entire instructional process and, thus, the subject of another paper. Affective instructional objectives are usually extremely difficult to measure. It is also suggested that rule-finding objectives be kept to a minimum in early childhood instruction because of the complexity of cognitive development they require.

Some early childhood educators have been criticized for developing instructional objectives that are beyond the developmental or maturational level of the child. Therefore, it is important that the maturational or developmental limitations of the child be taken into consideration when planning instructional objectives. For example, young children seem to be oriented to a concrete world. Therefore, it would be foolish to teach concepts that consist of highly abstract attributes (such as the concept inflation) until the child has learned concepts that consist of concrete, observable attributes such as color, size, shape, smell, texture, and so on. The pioneering work of Jean Piaget, the Swiss psychologist, and his colleagues, for example, can provide guidelines regarding suitable concepts to be taught young children (e.g., Flavell, 1963; Phillips, 1969; Piaget, 1926, 1952).

STEP 2: DETERMINE INSTRUCTIONAL PROCEDURES AND DISPLAY DEVICES

This second step in instructional development is primarily related to the instructional strategies and delivery systems components of the Merrill & Wood model (see Figure 1). This step can be viewed primarily as the plans and specifications prepared by the architect for a given building.

Inasmuch as the term "instruction" refers to the procedures intended to bring about specific behavior in the learner, it is important that the instructional procedures and resultant materials be determined according to the nature of the objective. Too often procedures and materials for early childhood are planned to "entertain" the child or, in other words, to keep him busy and prevent him from damaging himself, others, and important property. But instruction assumes the

child is kept busy doing those things which will help him achieve desired objectives (and incidentally prevent him from damaging himself, others, or valuable property).

There are three basic tasks for the instructional developer during this step: (1) Determine the primary presentation forms for content and for expected child responses; (2) determine the modes of representation for the primary presentation forms; and (3) determine instructional helps for the primary presentation forms. The Instructional Strategy Design Checklist (ISDC) in Table 3 summarizes the following discussion of these three steps.

Table 3 Here

Determine the Primary Presentation Forms for Content and for Expected Child Responses

It is postulated that effective instruction for any given identity, definition, or proposition must include three basic primary presentation display forms and one basic evaluation display form. That is, instruction for any given identity, definition, or proposition includes a statement of the rule for that content several worked example instances, several practice instances, and several test instances of the rule.

Any given concept or proposition (content) can be represented during instruction either as a generality (rule) or as an instance or example of the generality. A generality (G) is a definition of a concept, including its critical attributes, or a propositional statement of steps or procedures. An instance or example (eg) is a presentation of a referent (actual object, person, place, or event or a high-fidelity representation of the referent) representing the concept or the proposition. Identities have only one member of a set. Any given identity is the one and only

example of that identity. Therefore, there is no generality presentation for an identity and only one example.

The response mode refers to what the child is expected to do with the generality or instance. There are two modes, expository (meaning "to tell") and inquisitory (meaning "to ask"). In expository mode (E), the child is not expected to make a response to what is displayed but, rather, is expected to attend to the instructional display with one or more of his senses in preparation for a later response. In inquisitory mode (I), the child is expected to make some type of overt response to the instructional display such as pointing to something, singing, playing an instrument, telling something, and so on.

Figure 2 illustrates how primary presentation modes interact. The backbone of any instructional strategy is this relationship among primary presentation modes.

Figure 2 Here

The columns in Table 3 reflect the relationship among the primary presentation modes. Column 1, Rule (Generality), means that the content mode will be a generality and the response mode is expository (that is, the child is expected to attend to the instructional display with one or more senses rather than make an overt response to the instructional display). The symbol EG represents this expository generality relationship form. Column 2, Example, means that the content mode will be an instance rather than a generality and that the response mode is expository. The symbol Eeg represents this expository instance rela-

tionship form. Column 3, Practice, means again that the content mode will be an instance rather than a generality, and the response mode is inquisitory (that is, the child is expected to make a specified overt response to the instructional display). The symbol leg represents this inquisitory instance relationship form. Column 4, Test, has the same symbol, leg, as Column 3, Practice. This suggests that test items should be presented in the same form as practice items. Tests items, however, are administered separate from instruction even though they should be developed at the same time the other three primary presentation forms are developed.

The items in the first row of the checklist in Table 3 relate to guidelines for preparing the primary presentation forms. There is not space in this paper to elaborate on all of the guidelines in this Primary Presentation Form row. However, a few items need elaboration.

The model of instructional development suggested in this paper proposes that primary emphasis in most cognitive instruction in early childhood should be on instances that demonstrate a given rule or generality. Three of the four columns on the checklist (Table 3) relate to instances of the rule, not the rule--Example (2), Practice (3), and Test (4). There generally is no correlation between the child's ability to state the definition of a concept or the steps or procedures involved in a proposition (the IG or inquisitory generality box in Figure 2) and his ability to identify previously unencountered instances of the concept (definition) or to apply a set of steps or procedures in a proposition to previously unencountered conditions (the leg or Inquisitory example or instance box in Figure 2 and Columns 3 and 4, Practice and Test, in Table 3). That is, just

because a child can give the correct definition of "dangerous fire situation" does not mean he would recognize one if he saw one. Just because a child can tell the correct procedures to follow in a fire emergency does not mean he would demonstrate those same procedures in a simulated fire emergency. Therefore, there is no inquisitory generality (IG) primary presentation form suggested in this model of instructional development for early childhood. Unfortunately much, if not most, evaluation in formal schooling includes inquisitory generality test items. It is postulated that such items are generally unnecessary for effective instruction to be developed for early childhood--or for any other age period.

Items 2.1.2., 3.1.2., and 4.1.2 on the Checklist in Table 3 suggest that instances used in instruction should be in the same form as that specified by the objective. The objective is essentially a description of the test items to be used for evaluation of the effectiveness of the instruction. Therefore, primary instruction itself should consist of example and practice items similar in form to the test items. All three primary presentation forms should be in the form suggested by the objective. Here is an objective related to the concept, red:

> Given ten items not previously encountered in instruction, some of which are red and some of which are not, the child will correctly select all red items.

Now suppose that 10 test items were prepared that had previously been used in instruction (such as for Example and Practice Items). Such a form of evaluation would be for memory (recall) learning, not classification (concept) learning. Since classification behavior is suggested in the objective, the instances used for

test purposes must be similar to but not identical with those previously used in instruction (Merrill, 1971; Vance, 1973). Now assume ten pictures of different items were specified as test items for this objective. The objective requires real items not pictures of items. Further explication of the Checklist items in the first row of Table 3 can be found in Merrill and Wood (1975)..

Determine the Modes of Representation for the Primary Presentation Forms

Once the primary presentation forms for a given instructional objective have been determined the instructional developer must decide how each of these modes will be represented in instruction. Are you going to use real objects, a field trip, a movie, models, or simulations, or some other mode of instruction? And how will you expect the child to respond to these modes of representation? Your instructional objective will suggest your mode of representation. There are two basic types of representation modes that interact with each other as shown in Table 4: the instructional display mode and the response mode.

Table 4 Here

The instructional display mode is the mode in which the instruction will be represented for the child to observe and respond to. There are four such modes: firsthand, vicarious, secondary, and symbolic.

Firsthand instructional display mode (F).--This is a mode of representation where actual objects, persons, places, or events are used in instruction to

represent the content in the objective. In other words, the referent itself is presented during instruction. A visit to the dairy farm, as shown in Table 4, is an example of a firsthand mode of representation. The importance of firsthand representation is illustrated by a three-year-old boy visiting the zoo who was heard to exclaim as he stared at the caged tiger in wide-eyed wonder, "He's so big! The cat and tiger in my picture book are big as each other!" (Vance, 1973). It is probably a good rule of thumb for the developer of instructional programs for young children to plan firsthand modes of representation whenever possible, especially when introducing an identify, definition, or proposition for the first time. For example, if color concepts are being taught, real colored items should be used for the instructional displays. When counting is first being taught real objects should be used for counting. When spatial relationships such as over, under, around and through are being taught, real objects that can be manipulated in a variety of spatial relationships should be used in the instructional displays. When concepts or propositions about musical instruments are being taught, real instruments should be provided.

Vicarious instructional display mode (V). --It is not always possible nor practical to provide real objects, persons, places, or events during instruction. The event may not have occurred or has already occurred, the object is not available, the person or place is too far away. In such an event, simulated or vicarious representation can be planned--bringing the child as close as possible to the real thing. For example, if the children do not live by the seashore a model can be constructed with sand and water and perhaps even a fan to stir up "waves" in

the "ocean." If a visit to a dairy farm is impossible, one can be created in the prekindergarten with toy animals and farm buildings, some hay, sod, branches from trees, and so on. If a mother and baby cannot visit the class a lesson can be planned about babies using a doll, doll clothes, baby bottle, and other items related to the care of babies.

Secondary instructional display mode (Se).--Secondary instructional displays include pictures, drawings, filmstrips, movies, slides, videotapes, audiotapes, records and other "secondhand" display modes. Such displays should be used in early childhood instruction only after the children have experienced firsthand or vicarious displays relative to the same identities, definitions, or propositions.

Symbolic instructional display mode (S).--Symbolic representation refers to language and other symbolic structures used to represent the world. When an object, person, place, or event is described verbally or in writing but cannot be manipulated or perceived by one or more of the senses symbolic representation is taking place. Obviously the early childhood instructor is expected to give instructions, make comments, tell what something is, and so on, but whenever possible such symbolic representation should be related to a firsthand or vicarious representation of given content.

The response mode of representation is the type of response expected from the child relative to the instructional display. There are three types of response modes of representation: enactive, iconic, and symbolic.

Enactive response mode (En).--Enactive is a term referring to action or response. It is likely the infant and young toddler represent (process) information exclusively in the enactive mode. That is, the world to an infant or toddler is represented by a series of possible actions or psychomotor tasks with his world (Bruner, 1966). He probably is not able to process images until late toddlerhood. During instruction, if the child is expected to manipulate an instructional display, such as touch various fabrics, taste various foods, arrange objects in a display, such a response mode is called enactive. This is generally the most desirable response mode for early childhood instruction.

Iconic response mode (Ic).--Iconic refers to images or pictorial representation. When the child draws or paints a picture or model the response is in the iconic response mode. Such a response mode may be overused in early childhood instruction.

Symbolic response mode (Sy).--Whenever the child is expected to respond by writing, reading, or saying something, such a response is considered a symbolic response. Enactive and symbolic responses are generally combined in early childhood instructional development.

As indicated in Items 1.2.2., 2.2.2., 3.2.2. and 4.2.2. in the Checklist in Table 3, the mode of representation for any given primary presentation form should be in a form that will most likely allow processing of desired information by the child. For example, if you want the child to learn the correct procedures for escaping from his home when fire breaks out, you plan a vicarious display mode (a simulated fire situation in the home) where the child's expected response

mode will be application of the correct procedures. Using a symbolic instructional display mode (telling the child what to do only) and an expected symbolic response mode (the child telling you the correct procedures) is not likely to be successful because of the large memory load required and the fact that such modes of representation have little to do with the child's real world.

Determine Instructional Helps for the Primary Presentation Forms

Instructional procedures are not complete until instructional aids are provided to assist the child in achieving a given objective. These aids help the child process content information during instruction. Rothkopf (1965) has coined the phrase, "mathemagenic information," to refer to such aids or instructional helps. When such information is provided the child before he responds to an inquisitory display it is called prompting. This means calling the attention of the child to salient features of a display, not giving him the desired response. There are four basic types of prompting: mnemonic, attribute isolation, algorithm, and heuristic. Such prompts are used in rule and example displays (columns 1 and 2, row 3, Table 3).

Mnemonic.--A mnemonic is a memory aid to assist in later recall of specific information. For example, placing drawings or photographs in proper sequence to assist children in learning the words to a song is one use of a mnemonic during instruction.

Attribute isolation.--These are devices that focus the child's attention on the attributes of a concept. The child's attention can be focused on sounds, colors,

shapes, or other concrete attributes by the instructor either verbally or through a combination of verbal and motor (e.g., pointing) behaviors. For instance, during a lesson teaching the child to identify illustrated situations when it would be safe to light a fire, the instructor points to a picture of a fire laid in the fireplace and says, "It would be safe to light this fire (points to fireplace). The fire will stay where it is wanted because it is not piled too high and there is a screen (point). There is also something nearby to put it out in a hurry, this water (point to bucket of water on hearth)."

Algorithm.--Technically an algorithm is a rule for using a rule. It is viewed in instructional development as a step-by-step process for identifying instances of a concept or using a rule. For example, an algorithm for a child learning to identify triangles in a group of various shapes might be:

1. Find each side
2. Count the sides
3. If it has 3 sides, it's a triangle

Algorithms also assist the instructor in tracing back where a child might be having a problem if he responds incorrectly to an inquisitory display.

Heuristic.--A heuristic is a procedure for searching for the solution to a problem. It is an incomplete algorithm. It is probably most useful when the objective is a rule-finding one. Since there probably are few rule-finding objectives appropriate for young children there is likely little use for heuristics in the development of instruction for early childhood.

In contrast to prompting, feedback is the information provided the child following a response to an inquisitory (practice) display. There are four basic types of feedback useful for instruction in early childhood: right/wrong knowledge of results, correct answer knowledge of results, attribute isolation, and algorithm.

Right/wrong knowledge of results.--This merely indicates to the child that he was right or wrong. He receives no further information. For example, the instructor says, "correct" or "you're right" or "wrong" or "no."

Correct answer knowledge of results.--This is working out the answer for the child following his response to show him either why he was correct or why he was incorrect. Sometimes it is accompanied by right/wrong knowledge of results. For example, when the child is asked to select the triangles from a group of various shapes and incorrectly responds, the instructor may say, "No. Watch me. (Teacher mixes all shapes together again and then selects the triangles)."

Attribute isolation.--This focuses the child's attention, as with prompting, on critical attributes of a concept but in this case to assist the child in determining why he was correct or incorrect. For example, "No. This shows where it is not safe to light a fire. There is something to put it out (point to water tap and hose) but the fire won't stay where it is wanted because a wind is blowing (point to leaves and papers blowing around)."

Algorithm.--This is similar to an algorithm in prompting mode. However, the child's response now is used as part of the algorithm to show him why he was

correct or show him where he had his problem. For example, a child incorrectly selects "triangles" from a variety of shapes. The instructor picks up one of the incorrect shapes and says: "Here are the sides (pointing to each side on the shape). Now let's count the sides... (teacher and child count the sides) one, two, three, four." Then the teacher says, "This has four sides. A triangle has three sides. This is not a triangle." (Incidentally, if a child persistently made such a mistake it might be an indication he doesn't understand the concept, "sides." Therefore, instruction should be provided for the concept "sides" before continuing with the concept "triangle.")

Research Application of the Instructional Strategies Taxonomy

During the past few months some of my students and I have evaluated experimental instructional research studies in early childhood on the basis of the Instructional Strategy Design Checklist (Table 3). We have not yet found a study that illustrates more than half of the items on the Checklist in the instructional design of the experimental treatments. Seldom does an experimental treatment include the three basic primary presentation forms for instruction: rule, example, practice. Generally there is an implied rule, no examples, and some practice items (or a few examples but no practice items). Tests (criterion measures) are not directly related to the implied rule or to the examples or practice items. Generally we can predict the results of the study on the basis of the comparison between the treatments and the criterion measure, using the checklist in Table 3, without first seeing the results. Our predictions are based on the actual instructional strategies used in the study. Our predictions usually are at variance with the hypotheses of

the study. That is, we can often explain results on the basis of artifacts of training rather than on the basis of variables suggested in the study hypotheses. We have also found that many studies have varied several different variables in each treatment to the extent that it would be difficult to conclude what variables have caused what changes. For instance, one treatment will vary the statement of the rule and the mode of representation while another treatment in the same study will vary the number of examples used and the type of prompts given. It, therefore, becomes impossible to explain which variable or set of variables caused the differences in effects.

Recently I completed a pilot study of the effects of two experimental instructional treatments on the ability of children to:

(a) identify situations between children that make one child angry at another (classification behavior)

(b) describe what to do when one child becomes angry at another (rule-using behavior). (The rule is: 1. Tell the child what he or she did to make you angry; and 2. tell the child what he or she can do so you won't feel angry anymore.)

The instructional program in both treatments met all criteria on the Instructional Strategy Design Checklist (Table 3). The variable manipulated in the study was mode of representation. The instructional display mode used in Treatment A was a combination of vicarious and symbolic with two puppets. The response mode for Treatment A was a combination of enactive and symbolic, where the children manipulated the puppets to provide "acting-out" and verbal feedback with practice items. The instructional display mode used in Treatment B was secondary, a set

of colored pictures each of which depicted an interaction between two children. The response mode for Treatment B was symbolic only, where the child verbally described something related to each picture.

The sample of children used in the study was small: only 6 children. Therefore, significant differences were not expected. However, some interesting trends developed during the pilot study. The criterion measure included both pictures and puppets as the modes of representation. There were six previously unencountered items measuring the classification test and six previously unencountered items measuring the rule-using task on the test. Children who had been exposed to the puppets only during training were able to do the classification items with almost 100 percent accuracy (one child missed one item). Children who had been exposed to the pictures only during training performed with less accuracy (one child missed 2 items; one child missed 1). An even more interesting trend was noted on the rule-using tasks. Children exposed to puppets during treatment did better on test items using puppets. Children exposed to pictures during treatment did better on test items using pictures. However, no child in either group was able to demonstrate the second step of the rule. No child did very well on the rule-using task during the test. This raises some developmental questions, especially in light of the reasons children gave for some of their answers. The children tended to respond to the here-and-now quite well but in no case could project something into the future. Also, in spite of training, children became so involved in the test they tended to respond as they would emotionally in a real conflict situation (e.g., "Stop that!" or "My mommy doesn't like people who do that to me!") rather than the way

they had been taught to respond cognitively in vicarious or secondary situations during treatment. Thus, by producing instruction based on the taxonomy suggested in this paper, research results can now pin-point more accurately what some of the developmental limits of children may be at various stages relative to various types of instructional content and objectives.

Research Questions Suggested by the Taxonomy

The taxonomy provides a framework for the asking of instructional research questions and the production of hypotheses based on developmental study results combined with items in the taxonomy. The following are just a few of the research questions that might be considered for further study:

Primary presentation form.--What comprises an adequate sample of instances from any given definition (concept) or proposition domain? How can learning be measured in a child when he is limited in the number of instances he can cope with at any one time? How can the number of instances a child can cope with be measured? What are the developmental differences relative to type of definition statements and proposition statements the child can cope with (e.g., How many critical attributes in a definition can a child process? What degree of abstraction can a child process in a critical attribute within a definition or a step or procedure within a proposition? How many attributes or steps/procedures can a child process in a definition and a proposition?)? What constitutes matched examples and nonexamples and divergent examples for young children? What are the criteria for determining difficulty level of instances for young children? What is the best sequence in which generalities and examples and practice items should

occur? What is the role of learner control vs. instructor control of rules and instances in early childhood instruction?

Mode of representation.--What combination of instructional display modes and response modes is most effective for young children at various developmental levels relative to given types of identities, definitions, and propositions? What are the most effective ways to move from the simplest to the most complex mode of representation relative to any given definition or proposition? What combinations of sound and color and form and visual complexity of foreground and background are most suitable for instructional displays (and what are their limitations)?

Instructional help.--How much child response, if any, and what kind is most effective on example items for definition and proposition content objectives? What type of reinforcement is most effective during instruction and when should it be presented? What, if any, is the role of heuristics in early childhood instruction? Which types of prompting and feedback are most effective for identities and definition and proposition objectives in the various content areas of the curriculum?

Summary

This paper has suggested a taxonomy for the development of instructional strategies in early childhood education. This taxonomy relates to two basic steps in instructional design, the determination of instructional objectives, and the determination of instructional procedures and display devices. Subdivisions of each step have been described. A research application of the taxonomy has been discussed and some research questions have been presented based on the taxonomy.

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Table 1. Cognitive Components of Subject-Matter Areas of the Curriculum

COMPONENT	DEFINITION	EXAMPLES
Identity	An object, symbol, or event that is associated on a one-to-one basis with another object symbol, or event.	The child's name. The city/town in which the child lives. Mathematics symbols (e.g., +, −, =, x, ÷). Letters of the alphabet. The pet guinea pig in the classroom.
Definition	A statement describing the one or more common attributes (characteristics shared by a group of objects, people, places, or events (referents).	A child becomes angry with another child when the other child hits or pushes him or her, takes something away or ruins something belonging to him or her, or says naughty things to him or her. Things that can be set on fire with a match must be dry or must have oil or gasoline in them. A dangerous fire might get started if there is something that will burn and something that will make it burn.
Proposition	A statement describing the combination, operation or operations (steps or procedures) necessary to produce a given qualitative change in given conditions.	In order to find how many there are on the left side of the equal sign, add together all the numbers on the left side of the equal sign. When another child makes you angry by pushing or hitting you, taking something away or ruining something that belongs to you, or saying naughty things to you, tell that child what he or she did that made you angry and what he or she can do so you won't feel angry anymore.

Table 2. Types of Cognitive Instructional Objectives for Early Childhood Education

TYPE	DEFINITION OF CHILD RESPONSE	EXAMPLES OF OBJECTIVE
Memory	Recalling or recognizing a specific stimulus or set of stimuli (object, person, place, or event) previously encountered without prompting or hesitation.	Each child will correctly label without prompting or hesitation each of six substances he tastes as salty, sour, bitter, or sweet. Each child will correctly sing the words and melody of a given song without the use of prompts such as pictures, objects, or cues from the teacher. Each child will correctly select from a group of 5 objects previously used in instruction those that are smooth and those that are rough without prompting or hesitation.
Classification	Identifying the class membership (category) of a previously unencountered object, person, place, or event or its representation.	Each child will correctly select from a group of 5 previously unencountered objects those that are smooth and those that are rough. When given a group of 8 shapes of varying material and color not previously used in instruction, each child will sort into sets those shapes which are triangles and those which are squares. When given a group of dishes and eating utensils for a dinner table setting for 3 not previously used in instruction, each child will correctly put the glasses together, the forks together, the knives together, the spoons together, and the dinner plates together.

TYPE	DEFINITION OF CHILD RESPONSE	EXAMPLES OF OBJECTIVE
Rule Using (RU)	Producing the desired result or change when given previously unencountered instances of two or more conditions and process or procedure for achieving the desired result with the given conditions.	When given some dishes and tableware and glasses not previously used in instruction, each child will correctly set the table for dinner for three people, each place setting including a knife, a fork, a spoon, a dinner plate, and a glass. When given 5 previously unencountered problems requiring the addition of two numbers under 10 on the blackboard in this type of equation: 2 + 3 = _____ each child will correctly sum the two numbers in each problem.
Rule Finding (RF)	Finding or inventing one or more rules or procedures that will complete an ordered relationship between or among previously unencountered conditions and a desired outcome.	While listening to a record he has not heard before, each child will paint how he feels while listening to the record, using the easel, a large sheet of plain newsprint, an easel brush, and the three primary colors in separate paint bottles.

CONTENT: Identity ___
Definition ___
Proposition ___

Table 3
INSTRUCTIONAL STRATEGY DESIGN CHECKLIST (ISDC)*

TASK: Memory ___
Classification ___
Rule Using ___
Rule Finding ___

INSTRUCTIONAL STRATEGY VARIABLE	PRIMARY PRESENTATION FORM			
	RULE (Generality) (EG)[1]	EXAMPLE (Eeg)[2]	PRACTICE (Ieg)[3]	TEST (Ieg)[4]
PRIMARY[1] PRESENTATION FORM	1.1.1. The rule for the content in the objective is explicit, concise, and complete. If a definition: (a) the concept is named; (b) each of the critical attributes of referents of the concept is stated. If a proposition: (a) the desired result is identified; (this usually is the name of the proposition) (b) the operations (steps, procedures) to achieve the desired result are stated explicitly, and in chronological order (if order is critical); (c) there is an explicit statement of the conditions in which the operations of the proposition should be applied.	2.1.1. Instances are specific objects, people, places, events, or their representations. 2.1.2. Instances are in the form specified by the objective. 2.1.3. (If definition content) Each example is matched with a nonexample that has similar irrelevant characteristics. 2.1.4. Each instance is divergent from subsequent instances. 2.1.5. There is at least one minimum critical subset of instances. 2.1.6. Instances range from easy to hard. 2.1.7. Example instances are clearly identified and isolated from other primary presentation forms.	3.1.1. (Same as 2.1.1.) 3.1.2. (Same as 2.1.2.) 3.1.3. Each practice instance is different from any other example or test instance. 3.1.4. (Same as 2.1.4.) 3.1.5. (Same as 2.1.5.) 3.1.6. (Same as 2.1.6.) 3.1.7. Practice instances are clearly identified and isolated from other primary presentation forms. 3.1.8. There are at least as many practice instances as test instances.	4.1.1. (Same as 2.1.1.) 4.1.2. (Same as 2.1.2.) 4.1.3. Each test instance is different from any other example or practice instance. 4.1.4. (Same as 2.1.4.) 4.1.5. (Same as 2.1.5.) 4.1.6. (Same as 2.1.6.) 4.1.7. Test items are separate from instruction. 4.1.8. Test items are randomly sequenced.

*Adapted from Merrill, M.D. & Wood, N.D. Rules for effective instructional strategies. Instructional Design Series, Coursewave, Inc., Orem, Utah, 1975.

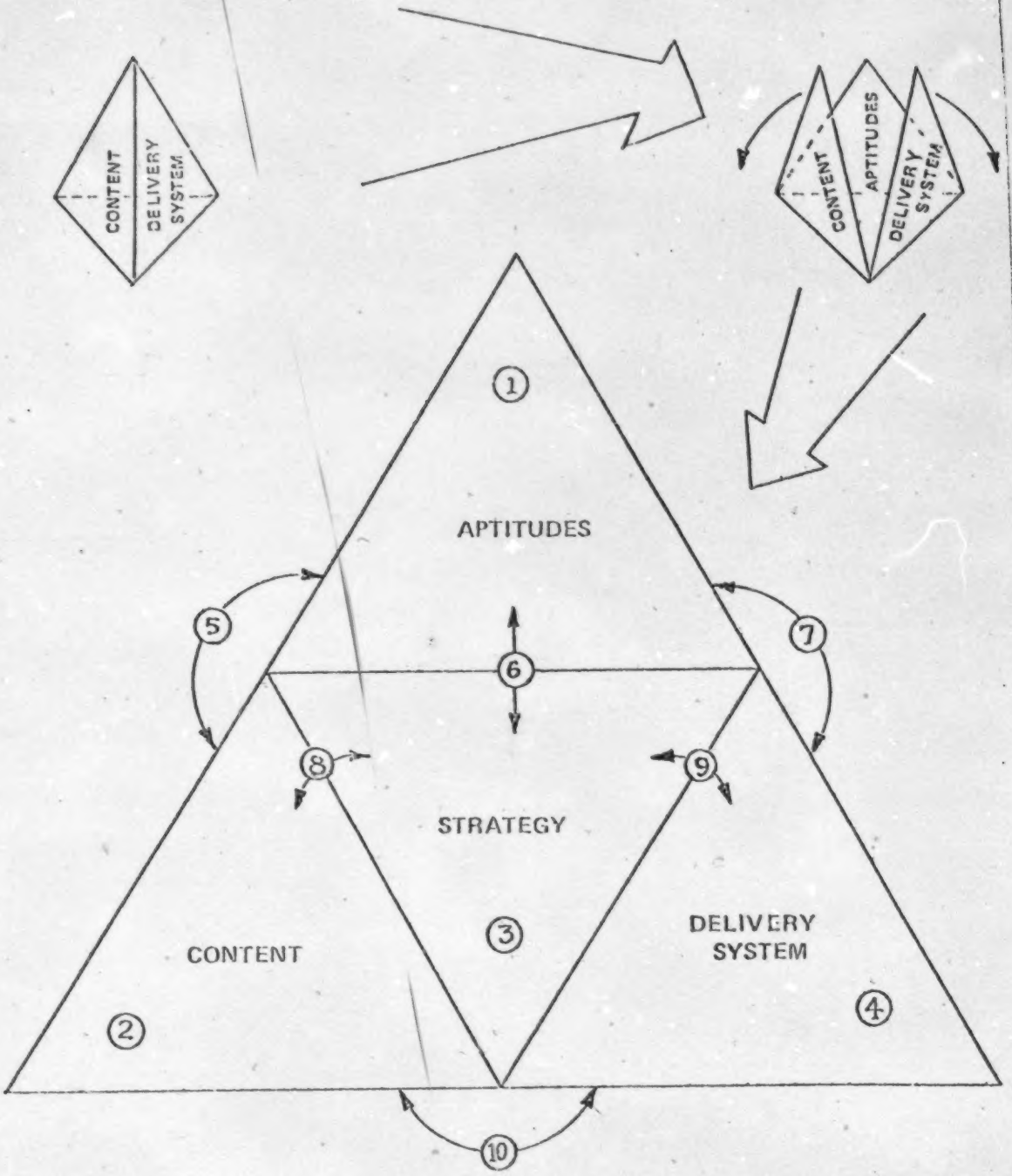
INSTRUCTIONAL STRATEGY VARIABLE	PRIMARY PRESENTATION FORM			
	RULE (Generality) (EG)[1]	EXAMPLE (Eeg)[2]	PRACTICE (Ieg)[3]	TEST (Ieg)[4]
1 PRIMARY PRESENTATION FORM (cont'd)	1.1.2. The rule (generality) is clearly identified and isolated from other primary presentation forms.		3.1.9. (If definition content) Early practice instances are matched with their nonexamples while later instances are not.	
2 MODE OF REPRESENTATION	1.2.1. The mode of representation for the rule is directly related to the test and that suggested in the objective. 1.2.2. The mode of representation for the rule is that which will most likely allow processing of desired information by the child.	2.2.1. The mode of representation for example is the same as that used for practice and test instances. 2.2.2. The mode of representation for all instances is that which will most likely allow processing of desired information by the child.	3.2.1. The mode of representation for practice instances is the same as that used for example and practice instances. 3.2.2 (Same as 2.2.2.)	4.2.1. The mode of representation for test instances is the same as that specified in the objective. 4.2.2. (Same as 2.2.2.)
3 INSTRUCTIONAL HELP	1.3.1. The elaboration of the rule (generality) includes some algorithmic and/or mnemonic prompts.	2.3.1 Each instance is accompanied by appropriate instructional prompts (attribute isolation if content is a definition; algorithm if content is a proposition).	3.3.1. Each instance is accompanied by appropriate instructional feedback (attribute isolation if content is a definition; algorithm if content is a proposition) as well as correct-answer knowledge of results.	4.3.1. Each test item is free of before-response instructional prompts. 4.3.2. Each test item is free of after-response instructional feedback.

Table 4. Modes of Representation for Early Childhood Instruction

INSTRUCTIONAL DISPLAY MODE

	Firsthand (F)	Vicarious (V)	Secondary (Se)	Symbolic (S)
Enactive (En)	F En Visit to a dairy farm (F); child touches cow, tastes milk from milker, feeds hay to cow, etc. (En).	V En A high-fidelity model of a dairy farm (V); child puts models of dairy animals and barns, etc. in place, drinks milk produced by cows (En).	Se En	S En
Iconic (Ic)	F Ic Visit to a dairy farm (F); child watches and listens as he or she walks about the farm, does not manipulate anything, draws a picture of what he or she saw (Ic).	V Ic A high-fidelity model of a dairy farm (V); child watches and listens, does not manipulate anything, draws a picture of what he or she saw (Ic).	Se Ic A movie, filmstrip, slides, photographs, or drawings of a dairy farm (Se); child observes then draws a picture of what he or she saw (Ic).	S Ic A written story about a dairy farm or instructor narrative about a visit to a dairy farm (S); child reads or listens, then draws a picture of what he or she thinks a dairy farm looks like (Ic).
Symbolic (Sy)	F Sy Visit to a dairy farm (F): child tells what he or she observes, asks questions, makes comments (Sy).	V Sy A high-fidelity model of a dairy farm (V); child tells what he or she observes, asks questions, makes comments (Sy).	Se Sy A movie, filmstrip, slides, photographs, or drawings of a dairy farm (Se); child tells what he or she observes, asks questions, makes comments (Sy).	S Sy A written story about a dairy farm or instructor narrative about a visit to a dairy farm (S); child tells what he or she read, or heard, asks questions, makes comments (Sy).

Figure 1. Instructional Development as a Tetrahedron*



* From Merrill, M.D. and Wood, N.D., Instructional Strategies: A Preliminary Taxonomy. ERIC Information Analysis Center for Science, Mathematics, and Environmental Education, The Ohio State University, Columbus, Ohio, November, 1974.

Figure 2. Primary Presentation Forms in Early Childhood instruction

Content Mode
(What is presented)

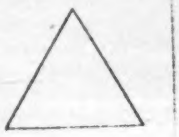
Response Mode (How it is presented)	G	eg
E	(1) EG "Rule"	(2) Eeg "Example"
I	(3) IG "Recall"	(4) Ieg "Practice"

Where:
G = generality
eg = example
($\overline{eg}$ = nonexample)
E = expository
I = inquisitory

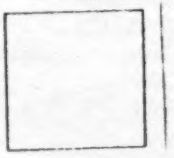
Examples: (definition or concept content)

(1) Expository Generality (EG) - "A triangle is a shape that has three sides."

(2) Expository Example (Eeg) - "This is a triangle:"



(Expository Nonexample ($\overline{Eeg}$) - "This is not a triangle:"



(3) Inquisitory Generality (IG) - "What is a triangle?"

(4) Inquisitory Example (Ieg) - "Here are five shapes. Find the triangles:"